

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

A389.7
R312E

UNITED STATES
DEPARTMENT OF AGRICULTURE
LIBRARY



BOOK NUMBER
872455

A389.7
R312E

UNITED STATES DEPARTMENT OF AGRICULTURE

Agricultural Research Service
Dairy Husbandry Research Branch
Washington 25, D. C.

Effects of a Whole Milk Diet and a Whole Milk Diet
Plus Various Supplements when Fed to Young Calves 1/

J. W. Thomas, M. Okamoto and L. A. Moore
Dairy Husbandry Research Branch
Agricultural Research Service
U.S.D.A., Beltsville, Maryland

Although milk is one of the best human foods, it has been known for over 57 years that young calves will not grow properly when maintained on an exclusive milk diet. Later work has amply demonstrated that milk contains insufficient amounts of vitamin D, trace minerals and magnesium to meet the needs of the young growing calf. It has been commonly thought that it was possible to grow calves to maturity on such a diet. This experiment was initiated to explore that situation and the probability that a synthetic milk might be developed and used as a basal diet with which to further study the fundamental nutritional requirements of calves.

In this experiment calves were kept in separate pens. The walls of which were covered with masonite to minimize consumption of wood and paint residues. Calves were fed milk from a bucket and occasionally turned out to exercise in a small paved yard. Milk was fed at 12% of body weight but calves older than 5 to 6 months would not consume this quantity of milk.

The first calves on this experiment were bedded on wood shavings or sawdust. Later calves were placed on raised wire screen floors when they were a few days of age. The growth of calves kept on shavings was greater than the growth of the calves kept on wire screens. This information is shown in Table 1.

Table 1

Comparative growth of calves with and without shavings as bedding when fed a milk diet. Rate of growth for the periods specified are expressed as a percentage of expected growth based on Bureau of Dairy Industry standards for the respective breed and sex.

Group	Age in days			
	0 - 30	0 - 60	0 - 90	0 - 120
On shavings	91 (10)	94 (8)	94 (4)	89 (3)
On screens	58 (16)	72 (15)	84 (9)	70 (7)
p	0.01	0.02	0.02	0.10

1/ Paper presented at the annual meeting of the American Dairy Science Association, State College, Pa., June 21-24, 1954.

In calves that were fed only whole milk plus vitamin D, an anemic condition was found to develop. When hemoglobin values decreased to about 7 gram per 100 ml. blood the calves were fed a supplement of either iron, copper and cobalt or of iron, copper, cobalt and manganese. The variation in the length of time for calves fed whole milk plus vitamin D to become anemic is shown in the data presented in the top portion of Table 2. After feeding the trace mineral supplements hemoglobin values usually increased to normal levels. The decrease in hemoglobin concentrations were also prevented by initiating the supplemental feeding when the calves were young.

Calves fed trace mineralized milk plus vitamin D developed a hypomagnesemia. This is indicated in the values shown in the lower portion of Table 2. Without supplemental magnesium, calves fed the milk diet died at from 35 to 300 days of age. The younger animals all died in a typical magnesium deficient convulsion while most older animals died in a similar manner. Some have died with other symptoms.

Table 2

Average level of blood constituents of calves fed
on whole milk plus vitamin D with number of calves
in parenthesis/

	Age in months									
	1	2	3	4	5	6	7	8	9	10
Hemoglobin (gm. %)	9.2 (44)	8.1 (47)	7.8 (34)	7.7 (34)	7.8 (17)	7.7 (9)	7.7 (4)	8.2 (2)		
Serum Magnesium (mg. %)	2.32 (28)	2.16 (28)	2.10 (26)	1.85 (23)	1.73 (19)	1.65 (13)	1.58 (9)	1.25 (7)	0.99 (5)	0.72 (1)

Calves fed the mineralized-vitamin D milk that died when less than 3 months of age were found to have no calcification in their hearts while 84% of the Jersey calves over 100 days of age had calcified areas in the heart. Seventy per cent of the crossbred calves over 100 days of age and 50% of the Holstein calves had calcified areas in their hearts when they died. The degree of calcification was much less in the afflicted Holstein calves than in the other calves.

The supplementation of a mineralized-vitamin D milk with ample amounts of magnesium has prevented the development of hypomagnesemia and calcification of the heart. When either magnesium sulfate, carbonate or acetate were added to the whole milk to bring the total magnesium intake up to approximately 2.3 gram of magnesium per 100 pounds of body weight there has been no hypomagnesemia or calcification develop in any animal so fed. Lower amounts of magnesium have allowed some degree of hypomagnesemia and calcification of the heart to develop in the older animals.

To date calves receiving the mineralized-vitamin D milk plus ample magnesium have failed to survive and have died at from 6 to 12 months of age. The following symptoms have usually been found, although not all simultaneously in the same animal: anorexia, excessive nervousness, listlessness, diarrhea, hyperthermia, septicemia, uremia, hyperphosphatemia, hypercholesterolemia, anemia, a slight hypercalcemia and upon autopsy an enlarged liver and kidney. Near the terminal stages supplementation with numerous items such as alfalfa, linseed meal, or water extracts of either alfalfa or linseed meal, liquid rumen contents, ascorbic acid, niacin, tocopherol, sulfa-drugs, aurofac, yeast or sodium propionate have not alleviated the symptoms nor prevented the ensuing death.

Many of these calves had pale and white muscles at the time of death, their plasma vitamin E level was very low and they had a high urinary creatine-creatinine ratio. Supplementing these calves with 100 or 200 mg. of alpha tocopherol acetate has prevented the white muscles, increased plasma vitamin E levels and lowered urinary creatine-creatinine ratio but it has not prevented the occurrence of the aforementioned symptoms and the resulting death.

Attempts to find substances that will cure the condition and alleviate these symptoms in calves have not been successful so that attempts to prevent the symptoms have been performed by the addition of various supplements to the mineralized-vitamin D milk plus magnesium. We have observed a great variability in the performance of calves fed the whole milk diets in their development of anemia, hypomagnesemia, symptoms at death and age at death.

One calf that was receiving mineralized-vitamin D milk plus ample magnesium was in such a condition at 130 days of age that it was estimated that it would die within one or two weeks. Its blood urea nitrogen at this time was 29 mg. per cent. The animal was fed alfalfa and was maintained for the next five months on this fortified milk plus one pound of alfalfa per day. During this time the blood urea nitrogen varied from 48 to 88 mg. per cent (about 2 to 5 times the normal value). When the alfalfa was omitted, in 10 days the calf was in a comotose state from which it did not recover. Blood urea nitrogen at this time was over 140 mg. per cent.

It is apparent that the young calf can not survive on a whole milk diet fortified with vitamin D, trace minerals and magnesium. It is probable that the growing calf requires still unidentified nutrients but that these nutrients are probably present in ordinary feeds or are synthesized in the rumen under normal conditions. A nutritional imbalance is another possibility that must be considered in calves that are fed an exclusive milk diet.



